Autonomous Learning Enhanced by Digital Pedagogy: Final Year Pre-service Teachers' Perceptions

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Abstract

Educators should harness the full potential of digital pedagogy to produce autonomous learners fit for the 21st century demands. Therefore, it is fundamental to assess digital competencies of pre-service teachers because they should be empowered to teach and produce a 21st century learner who is autonomous, intrinsically motivated, one who is a lifelong learner. A qualitative approach was utilised with semi-structured interviews to collect data from eighty (8) final year pre-service teachers at a University of Technology in South Africa. Participants were purposively selected to include four pre-service teachers training to teach in primary schools (BEd GET) and four pre-service teachers training to teach in secondary schools (BEd FET). Technological Pedagogical Content Knowledge (TPACK) framework was employed to assess pre-service teachers' digital technological competences. TPACK constructs were used to formulate interview questions. For robust, rigor and replicability of results data was coded, and themes were developed using thematic analysis. It was found out that pre-service teachers possess good technological knowledge but lack pedagogical knowledge to promote autonomous learning. It is recommended that Initial Teacher Education (ITE) should integrate digital pedagogy into their programmes and prepare the 21st century teachers with appropriate digital strategies to produce autonomous learners. Education as a vehicle for personal development and self-actualisation should provide tools that equip learners with autonomous learning. Autonomous learning does not only improve education results but also influences future career development.

Keywords: digital pedagogy, autonomy, learner, pre-service teachers, perceptions

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Introduction

Digital technologies are rapidly influencing all the sectors of the economy and education is no exception. In terms of education digital technologies have altered the pedagogical strategies gradually replacing the traditional ways of teaching. Several researchers have agreed that technological advancement is revolutionising education by encouraging autonomous learning (Panagou et al., 2025).

Initial teacher education plays a fundamental role in developing pre-service teachers' technological pedagogical expertise (Weisberg & Dawson, 2023). Teachers' digital competence is a vital research area because teachers play a key role in influencing future career development. While other studies focused on, leveraging technology in teaching, learning as well as technology's roles in education and society this research focused on how autonomous learning can be enhanced by digital pedagogy. The perceptions of pre-service teachers are also paramount to this research. Research has found that integrating digital technologies in teaching and learning significantly improves learning outcomes (Juan & Nagappan, 2025; Pratiwi & Waluyo, 2023). There is no single sector of the economy which is not positively affected by technological advancement. Investigating if pre-service teachers are competent to use digital pedagogy is relevant and aligns with current priorities in teacher education. Currently the aim of education should be to produce an autonomous learner, intrinsically motivated, one who is a lifelong learner (Hassan et al., 2020).

Like the constructivism collaborative epistemology's ideological philosophy digital pedagogy aims to produce autonomous learners (Mohammed & Kınyo, 2020). The apex in the acquisition of knowledge is dependent on the ability of the teacher to impact that knowledge using the type of pedagogy that excites learners. Digital pedagogy is believed to have the capabilities of exciting and promoting autonomous learners. Learner autonomy as defined by Sinclair (2008) can mean a learner who is intrinsically motivated and learns outside the classroom alone without any support from the teacher or the parent. Learner autonomy develops in the learning process which is stimulated by digital pedagogical strategies (Hafner & Miller, 2011). Digital pedagogy shifts the responsibility for learning onto learners which motivates them to take ownership of their learning. The teacher provides a learning space that enables learners to exercise their capacity for autonomous. Teaching has been made a bit simpler and enjoyable using digital tools. Research has demonstrated that technology as a pedagogical tool enables educators to produce learner-autonomy.

The development of open and collaborative web technologies contributed immensely towards the emergence of digital pedagogy. Waddell and Clariza (2018) postulate that digital pedagogy has become a method of empowerment whereby learners are motivated and encouraged to explore the learning space at their own capabilities. In the same rational digital pedagogy makes a significant contribution to participation and civic engagement through critical digital literacy (Istrate, 2022; Polizzi, 2022).

Digital pedagogy has made teaching an ideal composition of both art and science (Dhakal, 2022). Currently the art and the science of teaching involve the interplay between educators and machines. This interplay between educators and machines provides opportunities for learners to be creative, independent and autonomous. The fostering of autonomy skills enables learners to be aware of their learning needs and make decisions which are aligned to their learning goals. In terms of definition educationalists and linguists haven't reached consensus as to what autonomy really is. However, earlier researchers like Crome et al. (2009) defined

autonomous learning as the capacity to think for oneself as an acquired habit. Autonomous learning is not confined to the classroom settings only it contributes to learners' future careers.

Teaching strategies that promote autonomous learning provides a roadmap for innovation in the teaching and learning environment (Juan & Nagappan, 2025). Education as a vehicle for personal development and self-actualisation should provide tools that equip students with autonomous learning. Autonomous learning does not only improve education results but also produces learners who actively apply learning tasks and knowledge to the real world (Zhou et al., 2024). Autonomous learning promotes self- directed learning thereby improving learning outcomes (Slimi, 2020). Furthermore, digital pedagogy motivates learners to explore new content as well as enabling learners to be accountable for their own learning (Romanyshyn & Freiuk, 2024).

Digital Pedagogy

The study made use of the Technological Pedagogical Content Knowledge (TPACK) to critically evaluate the digital competences of pre-service teachers to promote autonomous learning at a University of Technology in South Africa. Croxal (2012) defines digital pedagogy as the use of electronic elements to enhance or change the experience of teaching strategies. While Howell (2013) refers to digital pedagogy as a study of how to use digital technologies to effect teaching and learning. Recent researchers define digital pedagogy as the pedagogical use of digital technologies (Shaikh, 2026; Väätäjä & Ruokamo, 2021). Digital pedagogy can also entail the pedagogical orientation which depends on curriculum goals (Väätäjä & Ruokamo, 2021). In terms of epistemological considerations digital pedagogy is a pedagogy of digitalisation of education (Istrate, 2022). Digital pedagogy has changed the landscape of education in many ways one of them is the enhancement of learner's understanding of the content being taught the same way the constructivist views deep learning. As constructivism point digital pedagogy encourages learner-centeredness, virtual facilities and asynchronous lessons (Istrate, 2022). In this vein digital pedagogy is that part of pedagogy that encompasses the design, implementation of the components of digital technologies and the utilisation of learning management platforms and tools.

The principal emphasis of digital pedagogy is on promoting motivated learners, learners who are autonomous. Teachers on the other hand gradually break away from the traditional teacher-centred teaching strategies. Masood and Haque (2021), as well as Agus (2026), also applause digital pedagogy by taking it as an ideal teaching strategy that gives students an open access to deconstruct, elaborate and critique information. In support, Shaikh (2026) maintains that digital pedagogy if used accurately can act as an efficient mechanism in promoting critical and analytical thinking of the students. The central focus is on how learners construct their own knowledge (Milton & Vozzo, 2013). Initial teacher education should pay attention to these new digital pedagogy practices and redesign their curriculum to meet these changes. The teaching approach should be aligned with the learning styles of the digital learner. Hence the subject matter must be delivered properly by using information technology (Absari et al., 2020; Juan & Nagappan, 2025). Pre-service educators must therefore be equipped with both subject knowledge and digital skills to promote learner autonomy.

Autonomous learning mechanisms in education involve learner initiatives and self-management skills (Juan & Nagappan, 2025). In a separate line of research Butler et al. (2017) also found out that digital technologies support students' collaboration, problem solving, and knowledge -construction. This study is significant because it establishes the exposure of the

pre-service teachers to digital pedagogy in the cultivation of autonomous learning. The study also informs Initial Teacher Education (ITE) on how to equip pre-service teachers with digital pedagogical tools which are aligned to autonomous learning.

Digital Pedagogy and Initial Teacher Education (ITE)

It is imperative that the Initial Teacher Education should empower pre-service teachers with relevant pedagogical skills. This is critical because digital tools are now the norm in teaching and learning. Teacher Education should be intentional in equipping student teachers with digital competences that enable them to produce autonomous learners. In agreement Sheikh and Nath (2026) argue that the fast-evolving digital technologies have significantly reshaped the education system coercing teachers to learn specific digital skills necessary for steering modern classrooms with greater agility. This is in accordance with the 21 st century learner who learns better with the aid of educational machines and digital tools.

Pre-service teachers lack required digital competencies, and this has been documented in several research publications (Dolezal et al., 2025; Sheikh & Nath, 2026). Teacher education should integrate digital literacy into their programmes. To make this a success a digital competence framework for educators should be developed. This was also proposed by Caena and Redecker (2019) who stressed the importance of a digital framework by pointing out that it is of paramount importance to align teacher competences to 21 st century teaching needs and challenges. Caena and Redecker (2019) recommend the use of the European Framework for the Digital Competence of Educators (DigCompEdu).

The European Framework for the Digital Competence of Educators can serve several purposes at different stages in Initial Teacher Education in promoting autonomous learners. The framework will not support teachers only but higher education institutions in terms of professional development. This empowerment can pave a way for institutional collaboration and the establishment of professional learning hubs. Initial Teacher Education should rethink the way they are preparing pre-service for digital classrooms. The integration of digital pedagogy in education is a significant trend that requires equipping pre-service teachers with new emerging digital pedagogies (Caena & Redecker, 2019). The new digital pedagogies stimulate new ways of thinking and improve learning outcomes (Binkley et al., 2011). The framework is needed to empower educators with relevant skills to meet the demands of the modern classrooms (Griffin et al., 2012). This should not be a framework for digital skills only but should be aligned to content and assessment to suit the needs of diverse learners. Additionally, the framework should be context based since national needs are culturally different.

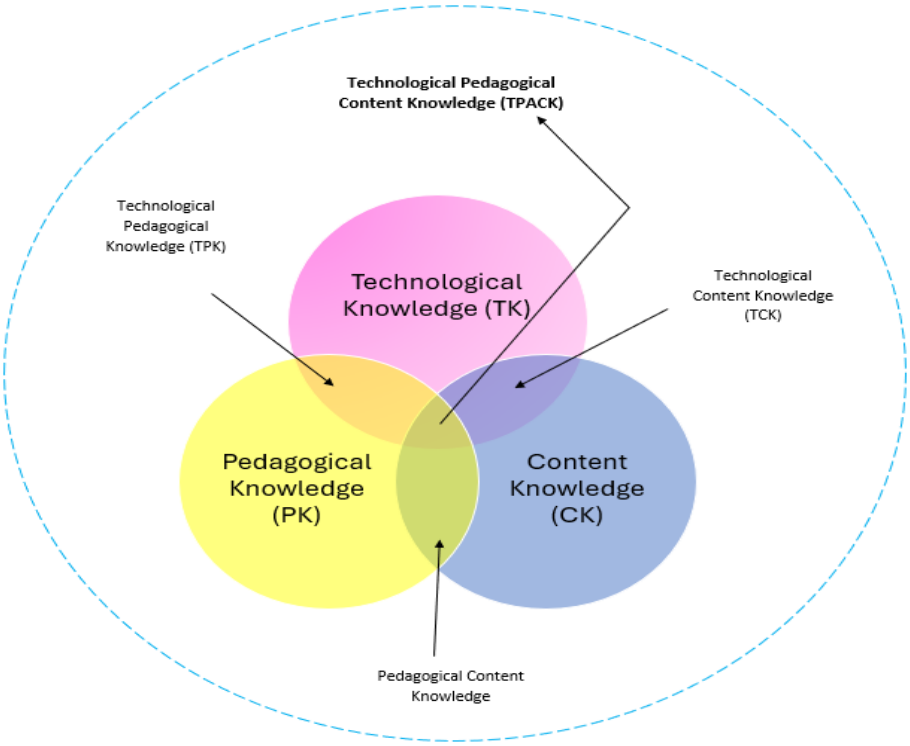
The European Framework for the Digital Competence of Educators (DigCompEdu) has been integrated into training programmes and guidelines in several countries such as Portugal, Spain Saarland in Germany (Caena & Redecker, 2019). South African Teacher Education institutions where this research was conducted should adopt this framework to empower pre-service teachers with digital competences required for the 21 st century teaching and learning environment. The Technological Pedagogical Content Knowledge (TPACK) is the framework which was used to find out if pre-service teachers at a University of Technology in South Africa were equipped with digital pedagogical skills to produce autonomous learners. The following section briefly illustrates the Technological Pedagogical Content Knowledge (TPACK).

Theoretical Framework

Technology is improving the quality of education by providing creative and innovative digital pedagogical tools. It is of critical importance to assess technological competences of both in-service teachers and pre-service teachers. However, this research focuses on pre-service teachers. To assess the digital pedagogical competencies of pre-service teachers the research utilised Technological Pedagogical Content Knowledge (TPACK). TPACK framework was developed by Mishra and Koehler (2006) to assist teachers to effectively integrate technology into teaching and learning. Researchers like Absari et al. (2020) ascertained that TPACK model has gained recognition among educational researchers because the model provides clear guidance on how teachers can use technology to improve the quality of learning. It is critical to assess pre-service teachers using the same instrument. The diagram below depicts the framework as proposed by Mishra and Koehler (2006).

Figure 1

Technological Pedagogical Content Knowledge (TPACK)



Note. Adopted from Punya Mishira and Matthew J. Koehler in (2006)

Currently effective teaching does not only require the understanding of content, what to teach and pedagogy how to teach but also how to integrate technology to enhance content and pedagogy. The 21 st century learning environment is viewed as a learning space where, pedagogy, content and technology intersect (Bahtiar et al., 2023). The Technological Pedagogical Content Knowledge (TPACK) framework tries to integrate the three main components of teacher knowledge, content knowledge, pedagogical knowledge and technological knowledge. The intersection of TPACK and autonomous learning brings a valuable insight to teaching and learning. Technological, Pedagogical Content Knowledge (TPACK) is a respected framework for technology integration in education (Deb et al., 2026). TPACK stemmed from the work of Shulman' Pedagogical Content Knowledge (PCK), which was expanded to incorporate technology (Gudmundsdottir & Shulman, 1987, as cited in Deb

et al., 2026). The inclusion of technology gives the framework more credits considering its relevance in this digital world. However, very few studies have aligned the framework with autonomous learning. The combination of autonomous learning and TPACK is commendable because this contributes to deep learning and cultivates the culture of lifelong learning. The research contributes immensely to the body of knowledge by unveiling the importance of digital pedagogy in promoting autonomous learning. TPACK has three components/ constructs which include Technological Pedagogy Knowledge (TPK), Pedagogy Content Knowledge (PCK) and Technology Content Knowledge (TPK). This research focused on Technological Pedagogy Knowledge (TPK). Technological Pedagogy Knowledge interacts with pedagogy and content to enhance learning experiences.

Research questions formulated for this study are as follows:

1. What is autonomous learning?
2. How familiar are you with digital tools that support autonomous learning?
3. How would you integrate digital pedagogical tools to promote autonomous learning?
4. What challenges or barriers do you foresee in using digital pedagogical tools?
5. What assistance do you need to be comfortable with pedagogical digital tools?

Methodology

Participants were selected from the Faculty of Education at a University of Technology in South Africa. A qualitative approach was utilised with semi- structured interviews to collect data from final year students. Participants were purposively selected to include four pre-service teachers training to teach in primary schools (BEd GET) and four pre-service teachers training to teach in secondary schools (BEd FET). Pre-service secondary teachers and pre-service primary school teachers were interviewed to find out if they are both well-equipped to employ digital pedagogy in their teaching with an attempt to promote autonomous learning. Technological Pedagogical Content Knowledge (TPACK) framework was employed to assess pre-service teachers' digital technological competences. The model was found to be appropriate for this study because of its major construct Pedagogy Content Knowledge (PCK), Content Knowledge (CK) and Technological Pedagogy Knowledge (TPK). The framework was used to identify if pre-service teachers are ready to integrate technology in their teaching. TPACK constructs were used to formulate interview questions. Data was analysed using systematic thematic analysis which enabled the research to develop themes and sub-themes. Each participant was assigned a pseudonym to conceal their identity for ethical reasons. Primary pre-service teachers' names were, P1, P2, P3 and P4, the letter P represents primary. Secondary pre-service teachers were S1, S2, S3 and S4, letter S represents secondary.

Data Analysis

Qualitative data were analysed thematically. The researcher started the analysing process with multiple readings of the transcribed interviews. Multiple readings enabled the researcher to be deeply familiar with the narratives of all the eighty participants. The extracted data were coded and categorised into themes according to research questions. The categorisation of data led to the development of 5 themes.

Theme 1: Autonomous Learning

Participants showed a clear understanding of autonomous learning. S4 pointed out that autonomous learning is when learners identify their own educational needs and manage their

time and the learning pace to make meaning of the world. P2 added that autonomous learning is where learners take full responsibility of their learning. Pre-service teachers displayed a general understanding of autonomous learning.

Theme 2: Digital Tools

Pre-service teachers are aware of digital pedagogy tools. P2 gave an example of Kahoot which offers quizzes and enables teachers to create flash cards and practical tests Most of the participants mentioned tools like, Padlet, ClassPoint and Google Forms. They also pointed out that they haven't used any of the tools. P4 said that they should be taught how to use Socrative to create exercises and educational games. Participants S2 shared that she was not familiar with any digital pedagogical tools. She added that she was still loyal to the use of textbooks and traditional teaching methods., However, she stressed that she was curious to learn more about them and how they can empower self- directed learning.

Theme 3: The Promotion of Autonomous Learning

Most of the participants knew digital pedagogy promote autonomous learning. P3 explained with excitement that digital pedagogy assists learners on how to tackle difficult concepts. S1 said he would use digital pedagogy in creating lesson plans that focus on learner, centred approaches and activities that can stimulate learners' interest. Participants showed a fair understanding of autonomous learning especially in self-directed learning. P1 shared that the promotion of autonomous learning is essential in empowering learners with critical thinking skills and competitive knowledge, skills needed for the 21 st century. Almost all the participants agreed that they should be equipped with digital pedagogy that enhance autonomous learning. They showed a higher level of awareness of the benefits of digital pedagogy as well as autonomous learning.

Theme 4: Challenges of Digital Pedagogy

The main predicament most of the participants pointed out was lack of professional training and poor internet connectivity especially in rural areas. P2 pointed that in remote areas where most the pre-service teachers will be teaching has limited access to digital devices and internet connectivity is also a challenge. They also stressed lack of exposure when it comes to digital pedagogy. Some of the participants blamed lecturers who are not modelling digital pedagogy properly.

However, participants showered willingness to acquire new skills and keep abreast of emerging digital pedagogical skills. Participant S3 pointed out that professional training would refine their technological pedagogical skills and improve learning outcomes. An overview of the responses given by most of the participants showed that they were aware of the challenges but also cognisance of the opportunities presented by the digital pedagogy, aiming to prepare learners for a technological environment and interconnected world.

Theme 5: Professional Assistance Needed

The main concern which stood out was the need for training. P3 stressed that pre-service teachers are willing to learn and implement new ways of teaching if they can be equipped to use such teaching methods. Pre-service teachers need formal training on how to integrate digital tools meaningfully into the curriculum.

Since the research was carried out in the South African context most of the participants said that they needed training in aligning digital tools with CAPs outcomes. The training should be aligned to the South African context. Participants stressed the importance of context as opposed to one -size fits all type of training. Context is critical in South Africa where resources and accessibility vary from region to region and totally different from the Global North. P1 and S3 alluded that student teachers need step-by-step tutorials that are designed for absolute beginners, showing users exactly where to click and what to do without assuming prior knowledge. This would remove the anxiety of exploring unfamiliar interfaces.

Discussion of Results

Participants showed a clear awareness that digital pedagogy can make teaching fun and interesting. This was also pointed out by Dhakal (2022), who is of the opinion that digital pedagogy has made teaching an ideal composition of both art and science. Most of the participants pointed out that they need proper training so that they would use digital pedagogy properly as also pointed out by several researchers (Absari et al., 2020; Avsec & Ferk Savec, 2021; Nagappan, 2025; Shaika, 2026). Pre-service teachers were also aware of digital pedagogical tools that enhances autonomous learning. This aligns well with what several researchers found out. Shaikh (2026) and Masood and Haque (2021) stated that digital pedagogy acts as a powerful tool in promoting critical and analytical thinking of the students. therefore, pre-service teachers should be empowered with technological pedagogy knowledge (TPK).

To make this successful a framework should be developed and be integrated into Teacher Education programmes. The framework should provide teachers with digital teaching competences. The framework will not only assist teachers to identify their strength and weaknesses but it's real power as a catalyst for change is displayed in collective applications (Bashır & Jımmy, 2023; Caena & Redecker, 2019). A framework like this also encourages teachers to be reflective practitioners. The acquisition of this knowledge would give teachers the opportunity to set up learning environment for deep learning experiences that would uncover and boost learner autonomy.

One of the participants S4 pointed out that as student teachers they should be professionally developed through workshops and seminars on how to use digital pedagogical tools properly. S4 is supported by researchers like Fullan and Langworthy (2014) and Shaikh (2026), who postulated that learning partnerships of students and teachers, tapping on their intrinsic motivation and integrating system-change knowledge, pedagogy and technology would catalyse the development of indispensable competences, collaboration and creativity. This would tremendously enhance teachers' technological pedagogy knowledge and teach with the intention of producing autonomous learners (Sheikh & Nath, 2026). This will in turn help learners to take ownership of their learning through ongoing assessment and continuous engagement with digital learning tools. One of the participants also pointed out that they need step- by step kind of training this is also in agreement with Caena and Redecker (2019) who are of the opinion that the digital pedagogical framework should engage its end-users from grassroots level and use professional activities which teachers can relate. This will motivate and encourage pre-service teachers to use digital tools and boost their confidence. This is supported by Dolezal et al. (2025) who said that pre-service teachers need profound professional digital competences to be able to effectively foster learners' digital skills. Moreover, Ros (2024) is of the view point that benchmarks are ideal for best practices. Such strategies will assist Initial Teacher Education to identify and actualise proven technological

teaching practices that amplify digital pedagogy in the classroom and enhance autonomous learning.

Conclusion

This research offers valuable insights for Initial Teacher Education to integrate digital pedagogical tools into the learning programmes. Thematic analysis revealed that pre-service teachers are not adequately prepared to foster digital competences and let alone to promote autonomous learning. Education as a vehicle for personal development and self-actualisation should provide tools that equip learners with autonomous learning. Autonomous learning does not only improve education results but also influences future career development. It is critical for teachers to encourage learners to be independent learners and lifelong learners.

More importantly Initial teacher Education should develop a framework to integrate digital pedagogical skills into the teacher education curriculum and foster digital competences. The European Framework for the Digital Competence of Educators (DigCompEdu) might be relevant to implement since other countries have adopted it and proved to be useful. The focus should not only be on subject content but also on technological pedagogical knowledge which is now an important integral part of teacher education. Pre-service teachers should be equipped with operational skills, ethical awareness, data literacy and the ability to use digital pedagogy effectively. It should be emphasised that taking advantage of the emerging digital technologies in education calls for a change in pedagogical practices, curriculum design and implementation. Additionally, the study highlights the need for context-based frameworks, professional support and inclusive practices.

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